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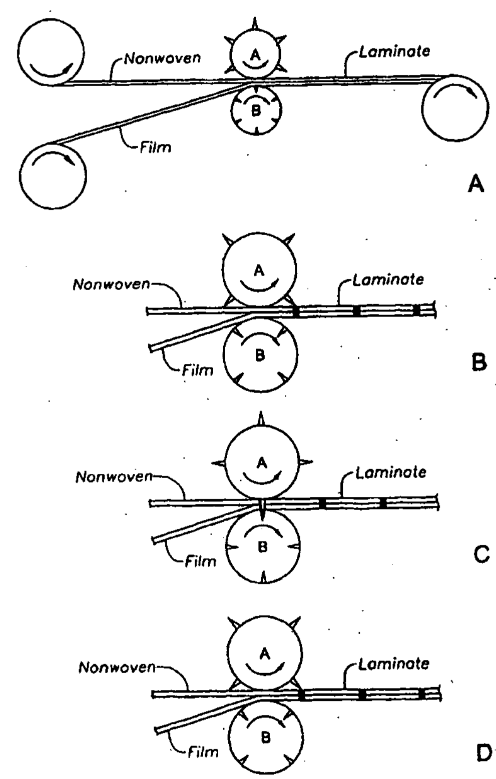
(54) Title: BREATHABLE ELASTIC LAMINATES

(57) Abstract

Laminates of elastic film and non-woven material and articles made therefrom exhibit relatively high WVTR and elasticity to provide comfortable disposable or single use garments. The laminates are made using a process wherein lamination and perforation are performed contiguously or simultaneously. The lamination/3996perforation process may include fusion or needle perforation.



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BREATHABLE ELASTIC LAMINATES

RELATED APPLICATIONS

This application claims the benefit under Title 35 United States Code §119(e) of U.S. Provisional Application No. 60/104,947, filed October 20, 1998.

BACKGROUND OF THE INVENTION

Technical Field

This invention relates generally to polymeric non-woven. elastic film laminates. More specifically, this invention is directed toward perforated elastic films laminated to a non-woven fabric that is treated such that the resulting laminate is elastic in the cross or transverse direction, or both and may be elastic in the machine direction.

Background

In the disposable garment market there is a longstanding and continuous need for more flexible garments and garments that breathe. Flexibility is needed so that the wearer can be active without feeling constricted by the garment, elasticity is needed, because, once flexibility is achieved, elasticity provides the wearer with a garment that retains or returns to its original shape after being flexed. At the same time, in all synthetic or polymeric garments, comfort similar to natural fabrics is the goal. Often synthetic fabrics used in durable or disposable garments give the wearer an uncomfortable feeling, as the moisture from perspiration and normal body respiration are not passed out of the garment and into the ambient air. Making a breathable synthetic fabric or film has occupied a large number of technical efforts.

It is against this backdrop that many consumer disposable garment manufacturers find themselves placed. Consumer disposables include diapers, adult incontinence products,

surgical gowns, surgical drapes, and the like. The manufacturers of these products desire a garment that not only provides the wearer with freedom of movement, but a comfortable garment as well.

U.S. Patent No. RE35,206 suggests post-drawing a nonwoven web under certain conditions; the fibers making up this web are restructured to provide the web with reduced pore size and a narrower pore size distribution. Such post-treated webs are purported to have unique pore size, directional absorption, and elastic recovery properties.

U.S. Patent No. 5,592,690 suggests that garments and other articles should include an elastic laminated sheet having the properties of stretchability and recoverability. The laminate includes an elastic laminated sheet made from a nonwoven fibrous web and an elastomeric film. The elastomeric film may be liquid impermeable or, alternatively, various degrees of air or vapor permeability may be achieved in the elastic sheet using mechanical microvoids or perforations. This document does not disclose or suggest a method of lamination or any means of perforating.

U.S. Patent No. 5,422,172 suggests that an elastic laminated sheet can be made from a nonwoven fibrous web and an elastomeric film. The laminated elastomeric film is recoverably stretchable to provide elasticity to the laminated sheet. Lamination by extrusion or adhesion of the nonwoven fibrous web to the elastomeric film are suggested. In-line lamination and incremental stretching are also suggested. Various degrees of vapor or air permeability are suggested, using mechanical microvoids. Among the suggested applications are diapers, pants, surgical gowns, sheets, dressings, and hygiene products.

Non-woven polymeric materials are known, as are treated or consolidated non-wovens, where such treatment or consolidation acts to render the non-woven elastic in the

cross or transverse direction. Also known are elastic films that have a high degree of elasticity. Preparation of films having good breathability, as measured by water vapor transmission rate (WVTR) using highly filled polymers, usually polefins, are also known. However, there is still a commercial need for fabric that can be made into an elastic, flexible, and breathable garment.

SUMMARY OF THE INVENTION

We have discovered that a laminate made from at least one mono- or biaxially-elastic or stretchable non-woven web and an elastic film where the laminate is breathable, delivers a result that can be made into a garment that has both stretchability as well as breathability.

Further, we have discovered that a non-woven/elastic film laminate having good breathability, in terms of WVTR, can be formed in a process comprising laminating a uniaxial or biaxially stretchable non-woven web and an elastic film by a lamination means that also perforates the laminate contemporaneously, rendering the laminate both stretchable and breathable. The laminate will be stretchable in the transverse or cross direction (CD) over a range of about 3% to about 350%, in the machine direction (MD) from about 1% to about 40%, and will have a breathability, or WVTR, exceeding about 5000 g/m^2/per 24 hours at 37.8 °C. Additionally, the laminate may include a moisture wicking function that is achieved by creating a fluid gradient established by making the naturally hydrophobic non-woven hydrophilic on one side, generally the side laminated to the naturally hydrophilic elastomeric film.

The lamination may be a stand-alone process performed on a previously perforated elastomeric film. Such perforation can be accomplished by needles, ultrasound, heat, and the

like. Alternatively, in a preferred embodiment, the stretchable non-woven web is laminated to the elastic film and perforation occurs at substantially the same time. The lamination can be fusion lamination, adhesive lamination, hot needle lamination. heat lamination, or combinations thereof. Perforation may be accomplished in either of the processes by using needles, hot needles, hydrosound, ultrasound, or by using combinations thereof.

Among the embodiments contemplated is a method of preparing an elastic laminate including an elastic film having a WVTR of at least about 1000 g/m^2/per 24 hours and a non-woven fabric having an elongation less than about 30% but greater than about 5%, comprising laminating the elastomeric film and the prestretched non-woven fabric, the lamination method being selected from the group consisting of fusion lamination, heat lamination, and hot needle lamination, wherein said lamination method imparts a breathability, or WVTR, to the laminate of at least about 1000 g/m^2/per 24 hours at a temperature of 37.8°C, wherein the laminate is stretchable in the cross or transverse direction, or both, over a range of about 5% to about 30%.

The foregoing aspects, features and advantages of the present invention will become clearer and more fully understood when the following detailed description is examined along with the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1A-1D illustrate a series of events within the lamination process of the present invention.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

Introduction

This invention includes certain non-woven fabric and elastomeric film laminates that simultaneously exhibit stretchability in the CD or MD, or both, breathability, and a method of making such breathable laminates.

In certain embodiments of the present invention, consolidated non-woven fabric webs, which have been previously known, and elastomeric films, also known, are combined using processes which simultaneously laminate and perforate the web and film components. In addition to cross or transverse direction (TD) consolidated non-woven webs, MD orientation of the non-woven (and elastomeric film) is also contemplated. This invention further includes certain elastomeric film and non-woven polymeric laminates, their conversion into fabricated articles such as diapers, adult incontinence apparatus, surgical gowns, surgical hats, surgical gloves, surgical footwear, surgical drapes, feminine hygiene articles, and other such articles wherein having good WVTR combined with good stretch and recovery properties are desirable. The resulting laminates have combinations of properties rendering them superior and unique to laminates previously available. While the properties of elastomeric film and non-woven polymeric laminates, along with methods of constructing them, are discussed herein, other methods of attaining a breathable stretchable fabric or garment will be known to those or ordinary skill in the art.

Production of the Laminate

Laminates contemplated by the instant invention may be made from a combination of consolidated or stretchable non-woven polymeric webs, constructed according to methods taught in U.S. Patent No. RE35,205, and an elastic or elastomeric film. Lamination may be

accomplished by any of the processes discussed herein. To make the resulting laminate breathable, another operation is performed, such as putting the laminate through interdigitating rollers in either the MD or the TD, or both, putting the laminate through a perforating means or mechanism, or other similar operations.

Those of ordinary skill in the art will appreciate that more than one consolidated non-woven web can be laminated to the elastic film. Also, other layers may be subsequently laminated or extrusion-coated onto the non-woven, elastic film laminate.

Additionally, in a preferred embodiment, lamination and perforation or other means of imparting breathability, in terms of increased WVTR, may be performed on the two layers simultaneously. In a preferred embodiment, the lamination/breathability process used is ultrasonic. In such a process, the points of welding also become microvoids or pores.

<u>The Elastic Film</u>

The elastic film of our invention can comprise one of several variations. Among these are monolayer elastomeric polymer films, coextruded films with an elastomeric core (as in a three-layer A/B/A film), or where the elastic film is one side of an A/B coextrusion. In the case of an elastomeric monolayer, the elastomer may be chosen from Styrene Isoprene Styrene, Styrene Butadiene Styrene, Styrene Ethylbutylene Styrene, Ethylene Propylene, Ethylene-Propylene Diene Terpolymer, and combinations thereof. Such elastomers may be compounded with typical elastomeric compounding ingredients that are well known to those of ordinary skill in the art. Additionally, the elastomer or elastomers may be blended with thermoplastics to improve extrudability. Such poleolefins may be chosen to enhance extrusion, but minimally detract from the elastic nature of the primary component, and include, but are not limited to, Ethylene Vinyl Acetate, Ethylene Methyl Acrylate, Ethylene-

Butyl Acrylane, Ethylene-Ethylacrylate, plastomers, Ultra-Low Density Polyethylene (i.e., density of less than about 0.9 g/cm^3), combinations thereof, and the like.

In coextruded elastic films, it is important that the film be elastic, or upon performing a laminating operation, the laminate must be elastic, and ultimately breathable. In one preferred embodiment, a polypropylene (PP) material is used as a part of the film coextrusion to enhance bonding to non-wovens which are often made of PP as well.
Preferred PP's are impact copolymer, homopolymer, and metallocene catalyst produced PP.

The Non-Woven Component

The non-woven component may comprise a consolidated non-woven fabric, similar to or identical to that disclosed in U.S. Patent No. Re: 35,206 or U.S. Patent No. 5,814,569 (incorporated herein by reference in its entirety for purposes of U.S. Patent practice) which is elastic prior to laminating. The elasticity of such webs as described in the aforementioned document is typically in the cross direction. While certain embodiments of our invention include such cross direction elastic webs, but we also contemplate certain stretchability or elasticity in the machine direction as an additional component of the laminate.

Certain embodiments of our invention include elasticity of about 5% or 10% to about 200% in the transverse direction (for the laminate), preferably about 40% to about 150%, and more preferably about 100% to about 150%. In an alternative embodiment, the laminate will have an elasticity in the machine direction of about 1% to about 10%, and preferably from about 3% to about 10%.

A preferred non-woven for use with various embodiments of our invention will include the extensibility or elasticity described above and additionally will have a two-layer design: the first layer (facing the wearer) will be made from fibers that are hydrophobic or

exhibit fluid repellency, such as PP. Such fibers will have a water contact angle greater than 90% as measured by a Rohm goniometer. The second layer (facing the elastic film) used in the present invention will have a hydrophilic treatment of such fibers, which can be accomplished by any method known in the art, including surfactant spray, or resin incorporation.

The non-woven used in various embodiments of the present invention, once stretched and treated, will typically include the characteristics of a microdenier pattern and low porosity as described in U.S. Patent No. RE35,206; microvoids present in the non-woven act as suction voids to force the moisture from the wearer's skin to the inside of the laminate, where it evaporates.

Laminating Process

Lamination may be carried out by any conventional means. However, in a preferred embodiment, the laminating process also perforates the film and thereby renders the laminate breathable. Specifically, we contemplate using hot needle or fusion lamination to accomplish the laminating and perforating goals. Of these, fusion lamination is preferred, wherein energy concentrated in small areas (approximately 10 x 10 μm) causes the layers of non-woven fabric and elastic film to fuse, along with creating a microvoid.

The preferred hot needle process and equipment for the lamination and perforation can be obtained from AFS in Germany, or Herrmann Ultrasonics in the United States.

Given the fact that a garment experiences several cycles of stretch and recovery as the wearer moves, the present laminate must exhibit resistance to delamination. Security is provided by insuring that the average peel force required to separate the layers is greater than about 150 g/m^2 and most preferably greater than about 300 g/m^2. In addition, in order to

maintain the desired elasticity, the bonding between layers should not exceed about 80% of the total area in contact between the film and the non-woven fabric.

The WVTR of the laminate produced as a part of the instant invention should be above about 100 grams of water per meter squared, per 24 hours (g/m^2/per 24 hours) at a temperature of about 37.8°C, 90% RH (Relative Humidity), preferably above about 1000 g/m^2/per 24 hours at a temperature of about 37.8°C, 90% RH, and more preferably above about 3000 g/m^2/per 24 hours at a temperature of about 37.8°C, 90% RH. For the purposes of the instant invention, WVTR is measured using the material sold under the name of Celgard™ 2400 (a porous polypropene), which has a standardized WVTR of 8740 g/m^2/per 24 hours, based on the ASTM 1249-90 testing protocol. Any of several test methods to determine WVTR can be used based on this standard and protocol, as are well known in the art.

It will be appreciated by those of ordinary skill in the art that the films comprising metallocene-polyethylene resins used in certain embodiments of the present invention can be combined with other materials, depending on the intended function of the resulting laminate. Other methods of improving and/or controlling WVTR properties of the film or container may be used in addition to the methods described herein without departing from the intended scope of the invention. For example, mechanical treatment may be applied to produce voids in the film, such as micropores.

EXAMPLES

A prestretched non-woven fabric produced by uniaxially drawing the non-woven in the MD according to the teachings of U.S. Patent No. Re: 35,206 is combined in a hot needle perforation nip with an elastic film that has a PP skin layer according to the process shown in

Figs. 1A, 1B, 1C, and 1D. The total percent bond area is greater than about 13%, the bonding resulting from in-situ melting and recrystallization between the PP in the non-woven fabric and the PP in the skin layer of the film. The bond appears as a polymer ring around the hole that the needle forms when perforating the film and the non-woven (see Figs. 1A, 1B, 1C, and 1D). The resultant laminate is breathable and extensible in both the TD and the MD.

As can be seen in Fig. 1A, the non-woven and the film components pass between a first roller A, and a second roller B. The roller A comprises a plurality of needles which are used to perforate the laminate as it is formed. As can be seen in Fig. 1B, the needles rotate in the machine direction, and perforate the laminate (see Fig. 1C) so as to form a void, which remains in the laminate after the needle is withdrawn (see Fig. 1D).

The elastic laminate of the present invention using an elastomeric film having a WVTR of at least about 1000 g/m^2/per 24 hours can be prepared by using a nonwoven fabric having an elongation at break (i.e., the nonwoven is stretched to a certain extent and then broken before lamination) of about 40% to about 300% by applying a lamination process to the nonwoven fabric and an elastomeric film. The lamination process can be selected from a group consisting of fusion lamination, heat lamination, thermo-mechanical bonding, or hot needle lamination. The lamination process will thereby impart a breathability, or WVTR, to the laminate of at least about 1000 g/m^2/per 24 hours at a temperature of 37.8°C, such that the resulting laminate is stretchable in the TD within a range of about 10% to about 200%. The laminate produced according to the method of the instant invention is stretchable in the machine direction over a range of about 3% to about 10%.

In an alternative embodiment, the method of the instant invention for preparing an elastic laminate which includes an elastic film having a WVTR of at least about 1000

g/m^2/per 24 hours and a nonwoven fabric having a TD elongation at break of less than about 300% and greater than about 10% to about 40%, wherein the fabric has a hydrophobic side facing a wearer and a hydrophilic side facing the elastic film, comprises laminating the elastomeric film and the fabric, using a lamination process selected from the group consisting of fusion lamination, heat lamination, thermo-mechanical bonding, or hot needle lamination, wherein the lamination process imparts a breathability, or WVTR, to the laminate of at least about 1000 g/m^2/per 24 hours at a temperature of about 37.8°C. The laminate is stretchable in the TD within a range of about 10% to about 200%. The resulting laminate typically has a TD extensibility between about 30% and about 200%, and a WVTR of at least about 5000 g/m^2/per 24 hours, and is capable of absorbing skin moisture at a rate of greater than about 1 ml/sec/m^2.

While the present invention has been described and illustrated by reference to particular embodiments thereof, it will be appreciated by those of ordinary skill in the art that the invention lends itself to variations not necessarily illustrated herein. For example, it is not beyond the scope of this invention to include additives with the claimed films or to blend resins to form the claimed films with other polymers or laminate the claimed films to other materials such as polymer non-wovens and the like. For this reason, then, reference should be made to the appended claims for purposes of determining the true scope of the present invention.

CLAIMS

What we claim is:

1. A method of preparing an elastic laminate, said laminate including an elastic film having a WVTR of at least about 1000 g/m^2/per 24 hours and a nonwoven fabric having an elongation at break less than about 300% but greater than about 40%, comprising:

applying a lamination process to said elastomeric film and said non-woven fabric; wherein said lamination process is selected from the group consisting of fusion lamination, heat lamination, and hot needle lamination, and wherein said lamination process imparts a wVTR to the laminate of at least about 1000 g/m^2/per 24 hours. wherein said laminate is stretchable in the transverse direction within a range of about 10% to about 200%.

2. The method of Claim 1 wherein said laminate is stretchable in the machine direction within a range of about 3% to about 10%.

3. The method of Claim 1 wherein said lamination process includes thermo-mechanical bonding.

4. A method of preparing an elastic laminate including an elastomeric film having a WVTR of at least about 1000 g/m^2/per 24 hours and a nonwoven fabric having an elongation at break of less than about 300% and greater than about 10%, said fabric having a hydrophobic side facing a wearer and a hydrophilic side facing the elastic film, comprises:

laminating said elastomeric film and said fabric, using a lamination process selected from a group consisting of fusion lamination, heat lamination, and hot needle lamination, wherein said lamination process imparts a WVTR to said laminate of at least about 1000 g/m^2/per 24 hours, wherein said laminate is stretchable in the transverse direction within a range of about 10% to about 200%.

5. An elastic laminate produced according to the method in claim 5 having transverse direction extensibility between about 30% and about 200% and having a WVTR of

at least about 5000 g/m^2/per 24 hours, wherein the laminate is capable of absorbing skin moisture at a rate of greater than about 1 ml/sec/m^2.

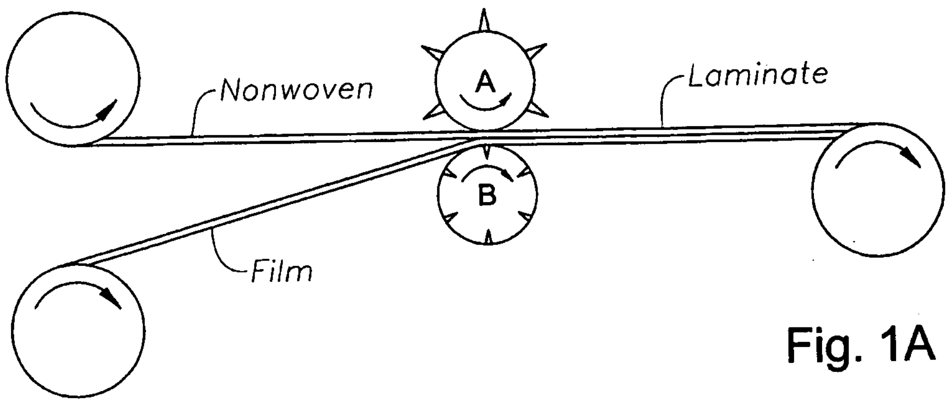

Fig. 1A

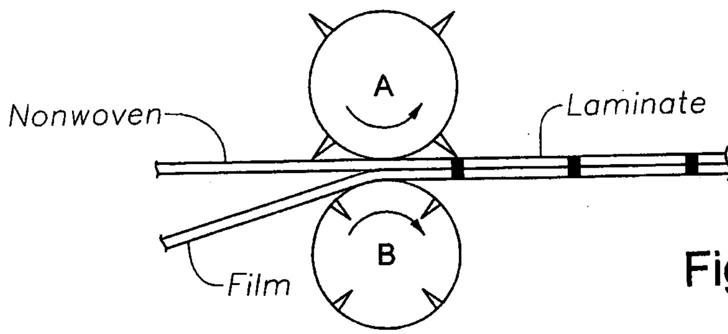

Fig. 1B

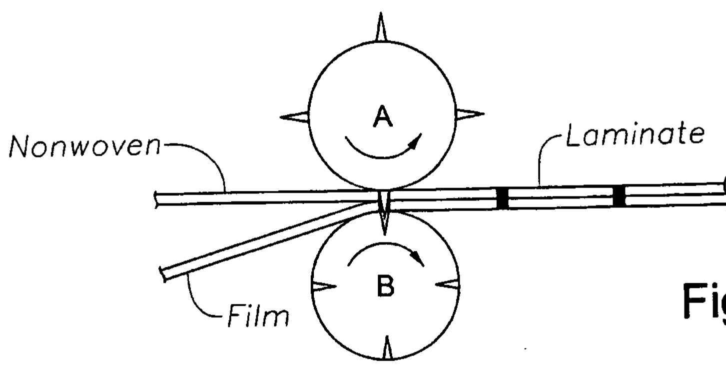

Fig. 1C

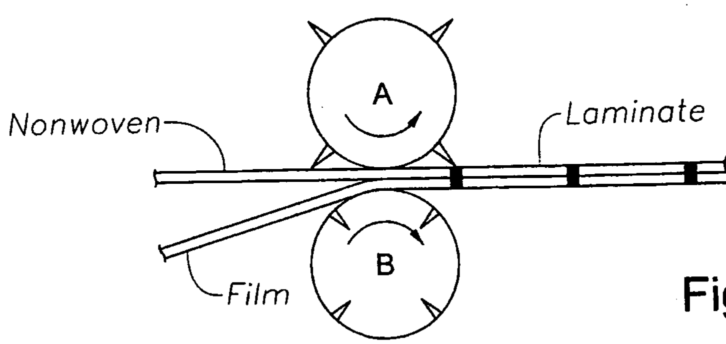

Fig. 1D

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B25/10 B32B31/00 A41D31/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 February 2000	25/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ibarrola Torres, O

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INTERNATIONAL SEARCH REPORT

Inte[rnati]onal Application No
PCT/US 99/24103

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int ional Application No
PCT/US 99/24103

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